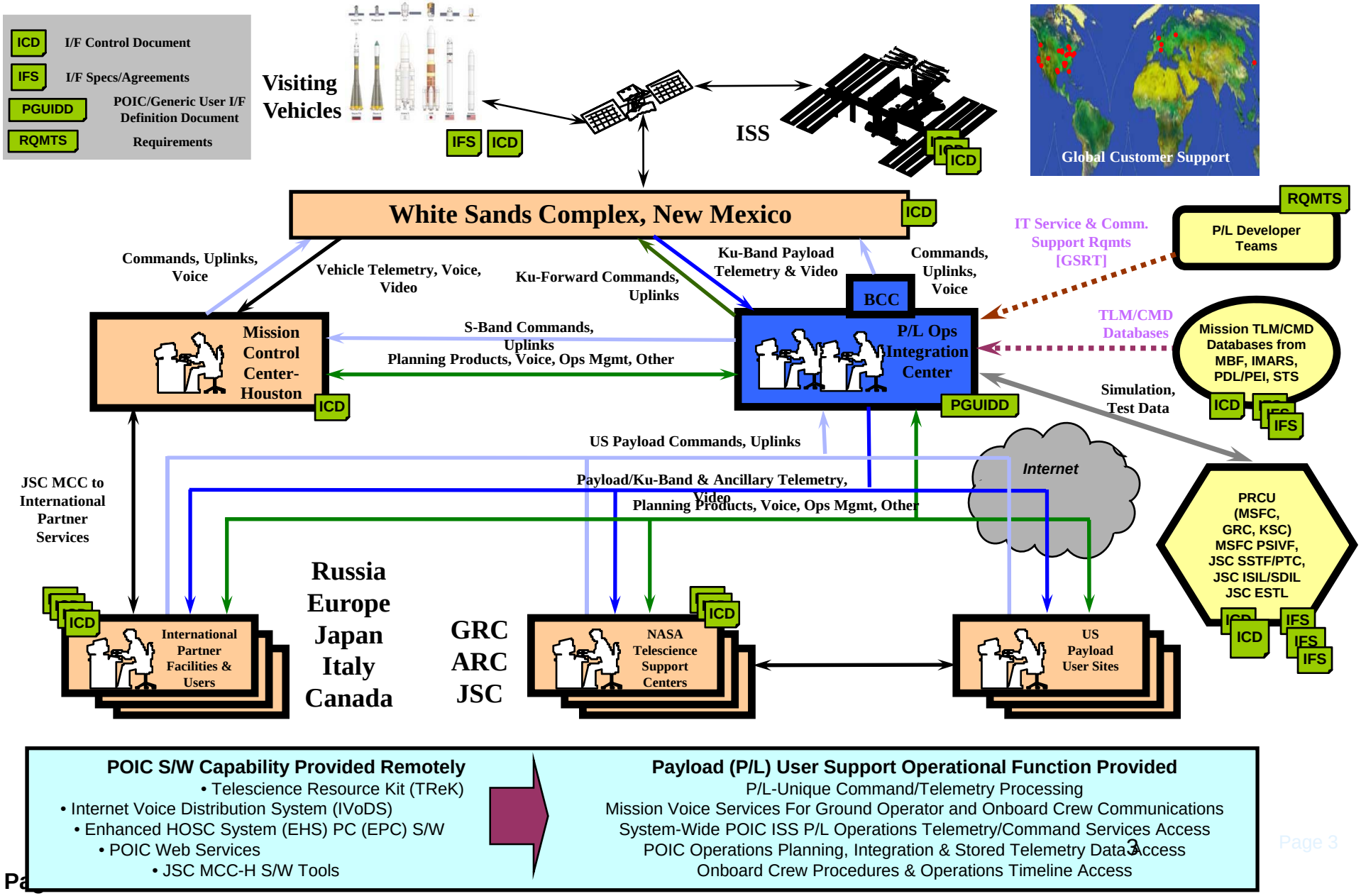
International Space Station Payload Operations & Integration Center (POIC) Remote User Services

EO04/Melanie Bodiford
Manager, POIC
Engineering Directorate
Mission Operations Lab
(256) 544-2067

ISS Payload Operations Integration Center (POIC)

- Primary facility and systems responsible for 24x7 real-time ISS payload operations management, integration, and control located at Marshall Space Flight Center (MSFC) in the Huntsville Operations Support Center (HOSC)
- Provide certified operations team, software and hardware systems to support ISS payloads and Shuttle for the POIF cadre, Payload Developers and International Partners
- POIC provides facilities and ground systems infrastructure for ISS payload operations:
  - Telemetry
  - Command
  - Operational Info Management Systems
  - Payload Planning Systems
  - Voice
  - Video
- Provide Backup Control Center for MCC-H in case of shutdown

ISS Payload Operations Distributed Architecture, POIC Services and External Interfaces



POIC S/W Capability Provided Remotely

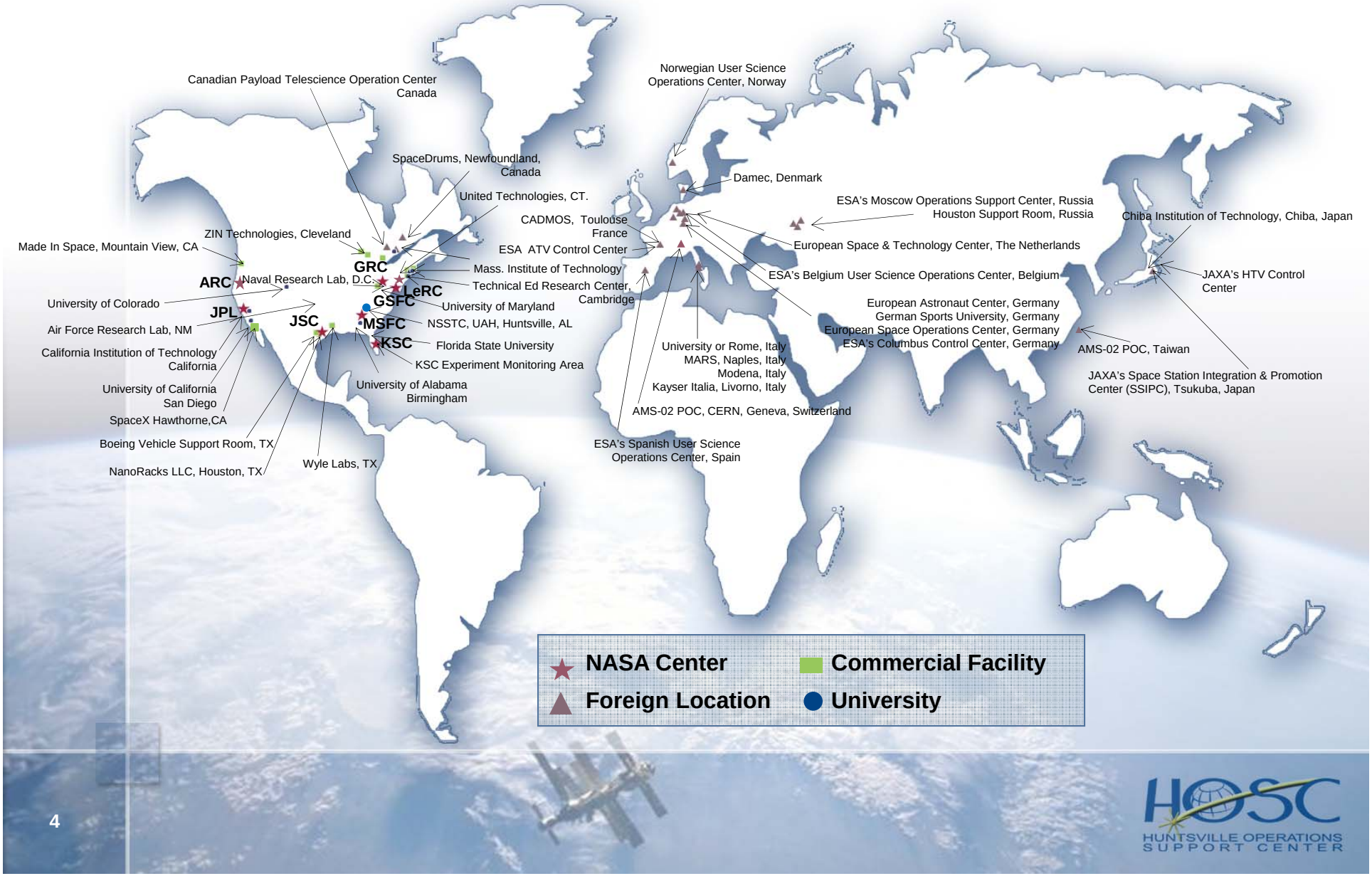
- Telescience Resource Kit (TReK)
- Internet Voice Distribution System (IVoDS)
- Enhanced HOSC System (EHS) PC (EPC) S/W
- POIC Web Services
- JSC MCC-H S/W Tools

Payload (P/L) User Support Operational Function Provided

P/L-Unique Command/Telemetry Processing
Mission Voice Services For Ground Operator and Onboard Crew Communications
System-Wide POIC ISS P/L Operations Telemetry/Command Services Access
POIC Operations Planning, Integration & Stored Telemetry Data Access
Onboard Crew Procedures & Operations Timeline Access

Marshall Space Flight Center

HOSC Remote Supported Sites



HOSC
HUNTSVILLE OPERATIONS SUPPORT CENTER

HOSC General: HOSC Supported Remote Sites

Universities	Northeastern University, MA. ■ Harvard University, MA. ■ Massachusetts Institute of Technology, MA. ■ Princeton University, N.J. ■ University of California at San Diego, CA. ■ University of Wisconsin, WI. ■ University of Alabama at Birmingham, AL. ■ California Institute of Technology, CA. ■ University of Colorado, CO. ■ Colorado School of Mines, CO. ■ University of Waterloo, Waterloo, Canada
U.S. Commercial Facilities	Henry Ford Health Clinic, MI. ■ Payload Systems, MA. ■ Lerner Research, OH. ■ Intek Inc., WI. ■ National Institute of Health, MD. ■ Boeing Vehicle Support Room, TX. ■ Wyle Labs, TX . ■ Boeing, WA. ■ Lockheed Martin, TX. ■ Orbitec, WI. ■ Hamilton Sundstrand, CT. ■ Chandra Operations Control Center, MA.
Foreign Locations	European Astronaut Center, GERMANY ■ Canadian Payload Telescience Operation Center, CANADA ■ ESA's Norwegian User Science Operations Center, NORWAY ■ ESA's Belgium User Science Operations Center, BELGIUM ■ ESA's Moscow Operations Support, RUSSIA ■ University of Paris, FRANCE ■ University of Rome, ITALY ■ German Sports University, GERMANY ■ European Space Operations Center, GERMANY ■ European Space and Technology Center, The NETHERLANDS ■ University of Waterloo, CANADA ■ Thomson & Nielson Electronics, CANADA ■ ESA's Columbus Control Center, GERMANY ■ JAXA's SSIPC, JAPAN ■ Damec, DENMARK ■ Italian Space Agency, ITALY ■ ESA's Spanish User Science Operations Center, SPAIN ■ Houston Support Room, RUSSIA ■ Mission Control Center-Moscow, Russia ■ European Center for Nuclear Research (CERN), Geneva Switzerland
NASA Centers	JSC Telescience Support Center ■ JSC DOD Payload Operations Control Center ■ JSC Build 4S Crew Office ■ JSC Space Station Training Facility ■ JSC SSCC/Bio Med Support ■ JSC Increment Scientist Support ■ MSFC United States Operations Control Center ■ MSFC Payload Software Integration & Verification (Boeing) ■ MSFC Regenerative ECLSS Support Room ■ GRC Telescience Support Center ■ AMES Telescience Support Center ■ JPL Earthkam Project Support ■ KSC Space Life Sciences Lab ■ KSC Florida State Research Institute ■ KSC Space Station Processing Facility KSC Boeing ■ GSFC SEM Payload Operations ■ Backup Advisory Team (remote locations) ■ Jacob Sverdrup, Engineering and Science Contract Group, Houston, Texas (PIMS, OSTPV/MPV, Voice)

POIC Capabilities and Interfaces

- POIC Capabilities are described in the POIC Capabilities Document, SSP 50304
- POIC provides several tools and services for remote users including system options. For users wishing to interface directly to POIC services, detailed interface and file format information for the development of interface software are defined in the POIC Generic User Interface Definition Document, SSP 50305.
- POIC provides access to services 24 x 7 to support CoFR activity.

SCIENCE OPERATIONS

POIC Integration/Services For Remote Users

Payload Command Uplink Gateway, Downlink Vehicle/Payload Telemetry Distribution, Voice Comm Control, Data Transfer Services, Planning Services, Information Systems, etc

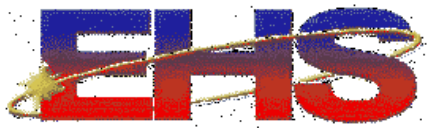
International Space Station (ISS)

POIC Remote User Services

(*italics denote planned capabilities within the next 6-18 months)

Tool	Services

Payload Data Services	• Receive, distribute (Class D Multicast or UDP), and storage (2 year) of science data
	• Receive, process, distribute, and storage (2 year) of ISS system parameters, payload health and status data, and visiting vehicle data (payload and carrier)
	• Intermediate capability for realtime data buffering
	• Collect and report statistics on user downlink data
	• Receive and distribute test/simulation data from other external sources to support payload test and checkout activities:
	  • KSC Space Station Processing Facility (SSPF)
	  • MSFC Space Systems Test & Integration Facility (SSITF)
	  • GSFC Telescience Support Center (TSC)
	  • JSC TSC
	  • JSC Systems Development & Integration Laboratory (SDIL)


Web and Portal
	• Browser-based secure access to mission support tools including:
	  • access to processed telemetry measurements and ground parameters
	  • retrieval of processed stored telemetry measurements and ground parameters
	  • retrieval and distribution of unprocessed stored telemetry and payload video (playback)
	  • access to online telemetry and command database query capabilities
	  • access to payload information and configuration management tools
	  • access to generate onboard automated command execution scripts (Timeliner)
	  • creation and distribution of user defined telemetry streams consisting of POIC processed data

Application Programmatic Interfaces (API)	Application programmatic interfaces (API) are provided to allow user-developed software access to the EHS telemetry and command services through inter-process communication. Details can be found in the POIC to Generic User Interface Definition Document (PGUIDD), SSP 50305, Volume 1 and 2.

POIC Remote User Services

(*italics denote planned capabilities within the next 6-18 months)

Tool	Services


Enhanced HOSC System PC Suite
	• Rich toolset to provide point and click creation to:
	  • Receive and display telemetry data on a user-defined display
	  • Perform computations on the received telemetry values
	  • Continuously monitor specific telemetry parameters to detect anomalies
	  • Update and uplink commands to the spacecraft
	  • Track and verify command uplinks
	  • Extensive scripting language for automated telemetry acquisition, command updates, and command uplinks
	• Can be combined with TReK to provide comprehensive processing of payload science and health and status data
	• *Provides access to Internet Protocols via POIC Ku-Band services as a communication path that will allow a remote user to communicate with their on-orbit Joint Station LAN (JSL) or Ethernet connected payloads using standard IP communication protocols*
	  • *Ping*
	  • *Remote Desktop to Express Laptops*
	  • *Http to onboard video encoders*
	  • *Https to file server*
	  • *Secure Shell*
	  • *CCSDS File Delivery Protocol (CFDP)*
	• *Provides access to POIC Delay Tolerant Network (DTN) node to ISS payload DTN node Internet Protocol communication supporting store and forward traffic during network interruptions*

POIC Remote User Services

(*italics denote planned capabilities within the next 6-18 months)

Tool	Services


Telescience Resource Kit (TReK) Suite
	• Receive, Process, Record, Forward, and Playback Telemetry data
	• Exception Monitoring (monitoring incoming data for out of range exceptions).
	• Send a Command to your Payload
	• Command Track (History of most recent commands sent from TReK System)
	• Record and View all command session activity -- commands sent and command responses received
	• Configure one TReK system to serve as a command server/filter for other TReK systems.
	• Automatically generate a display to view any telemetry TReK is processing. (No programming required -- just point and click).
	• Telemetry & Command Databases (telemetry & command processing information)
	Note: A TReK user has complete control over local TReK databases
	• Application Programming Interface that provide a way for you to access telemetry and command functions from your favorite COTS products to build data displays, computations, and scripts
	Note: The TReK product includes documentation and source code examples that show how to use the TReK application programming interface with Microsoft Visual C++ and Microsoft Visual Basic. The TReK Application Programming Interface can be used with any commercial product that supports an ANSI C interface.
	• *Provides access to Internet Protocols via POIC Ku-Band services as a communication path that will allow a remote user to communicate with their on-orbit Joint Station LAN (JSL) or Ethernet connected payloads using standard IP communication protocols*
	  • *Ping*
	  • *Remote Desktop to Express Laptops*
	  • *Http to onboard video encoders*
	  • *Https to file server*
	  • *Secure Shell*
	  • *CCSDS File Delivery Protocol (CFDP)*
	• *Provides access to POIC Delay Tolerant Network (DTN) node to ISS payload DTN node communication supporting store and forward traffic during network interruptions*
	Note: TReK Library routines for Internet Protocols and DTN can be used by the onboard payload to communicate with the remote user ground system.

POIC Remote User Services

Tool	Services


Payload Planning System
	• Automates planning, scheduling, and integration of payload operations during pre-increment planning, weekly planning and realtime execution
	• User Requirement Collection Tool (URC) – Enter payload planning
	  • Crew time
	  • Power
	  • Thermal
	  • Data
	  • Video/Photography
	  • Operational constraints

DICES VoIP
Voice
	• Windows-based Internet voice solution
	  • Monitors up to 24 loops/conferences simultaneously
	  • User selects from authorized subset of available voice loops/conferences
	  • Talk on one of the 24 loops
	  • Volume control and mute for individual loops
	  • Differentiate between talk and monitor privileges
	  • Show lighted talk traffic per loop
	  • Custom group configuration
	• *Candidate for Mobile App development*

Video	• Receive and distribute ISS and science video • Store science video for a minimum of two years • Distribution of science video is uncompressed high defintion and can be restricted as proprietary.
Other ISS tools	• Access to JSC Mission Control Tools needed to support ISS Payload Operations

POIC Remote User Services

(*italics denote planned capabilities within the next 6-18 months)

Tool	Services

 Customer Support	• Ops Concept Development
	• Ground Systems Interface Requirements analysis and integration
	  • Detailed explanation of services
	  • Recommendations for “best fit” set of services that satisfy ground operations concept.
	  • Assistance in development of ground system interface ISS documentation
	  • Assesses options and impacts for optional services
	• Provides single point-of-contact for ground system needs for the full life cycle
	  • Pre-mission (flight readiness)
	  • Mission (changes)
	  • Post-mission (access to stored data)
	• Ground System Interface Configuration
	• Ground System Interface Testing
	• Remote User Training
	• Payload Test & Checkout Support
	• Assists with Ground System Flight Readiness Certification
	• 24x7 Help Desk

POIC Contacts

- Ground Services Requirements Team (GSRT)
  - Philip Cauthen 256-544-4204 philip.cauthen@nasa.gov
  - Nick Bornas 256-544-5235 nick.bornas@nasa.gov
  - Dennis Botts 256-544-9363 dennis.botts@nasa.gov
  - Karl Roth 256-544-3539 karl.roth@nasa.gov
- POIC Help Desk: 256-544-5066

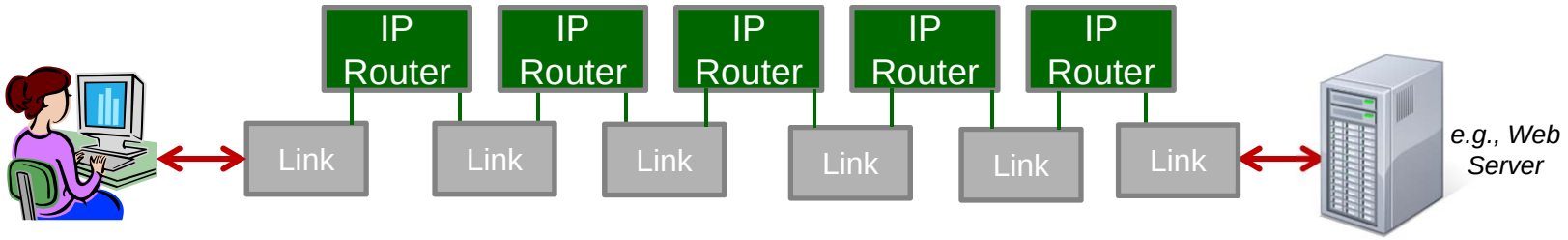
Page 12

BACKUPS

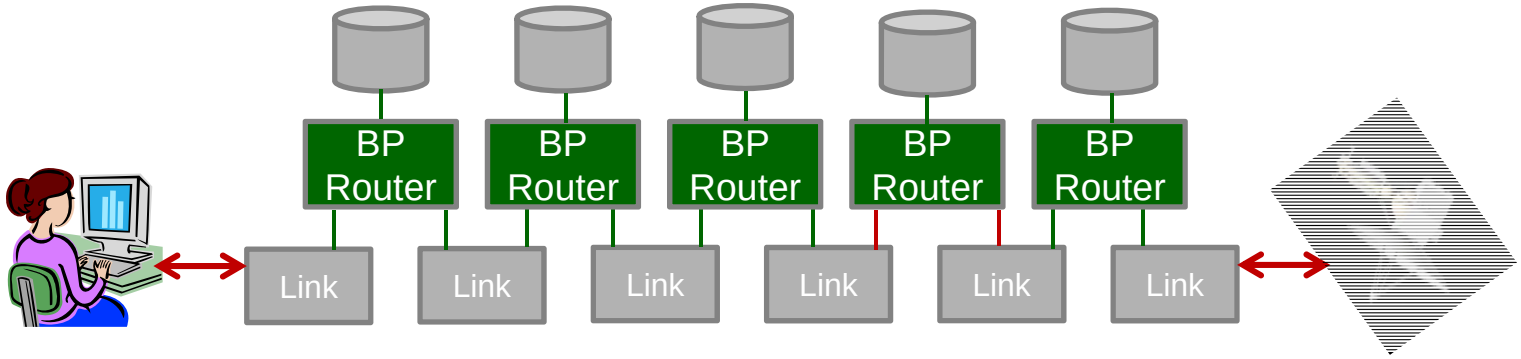
Page 13

What is DTN?

- DTN is actually a combination of protocols that are being developed to extend the terrestrial Internet into Low Earth Orbit (LEO) and beyond to help form the Solar System Internet
- The terrestrial Internet works by connecting multiple individual **links** into an end-end path using Internet Protocol **(IP)** routers. The end-end path is always available, delays are short (a few milliseconds) and error rates are very low.



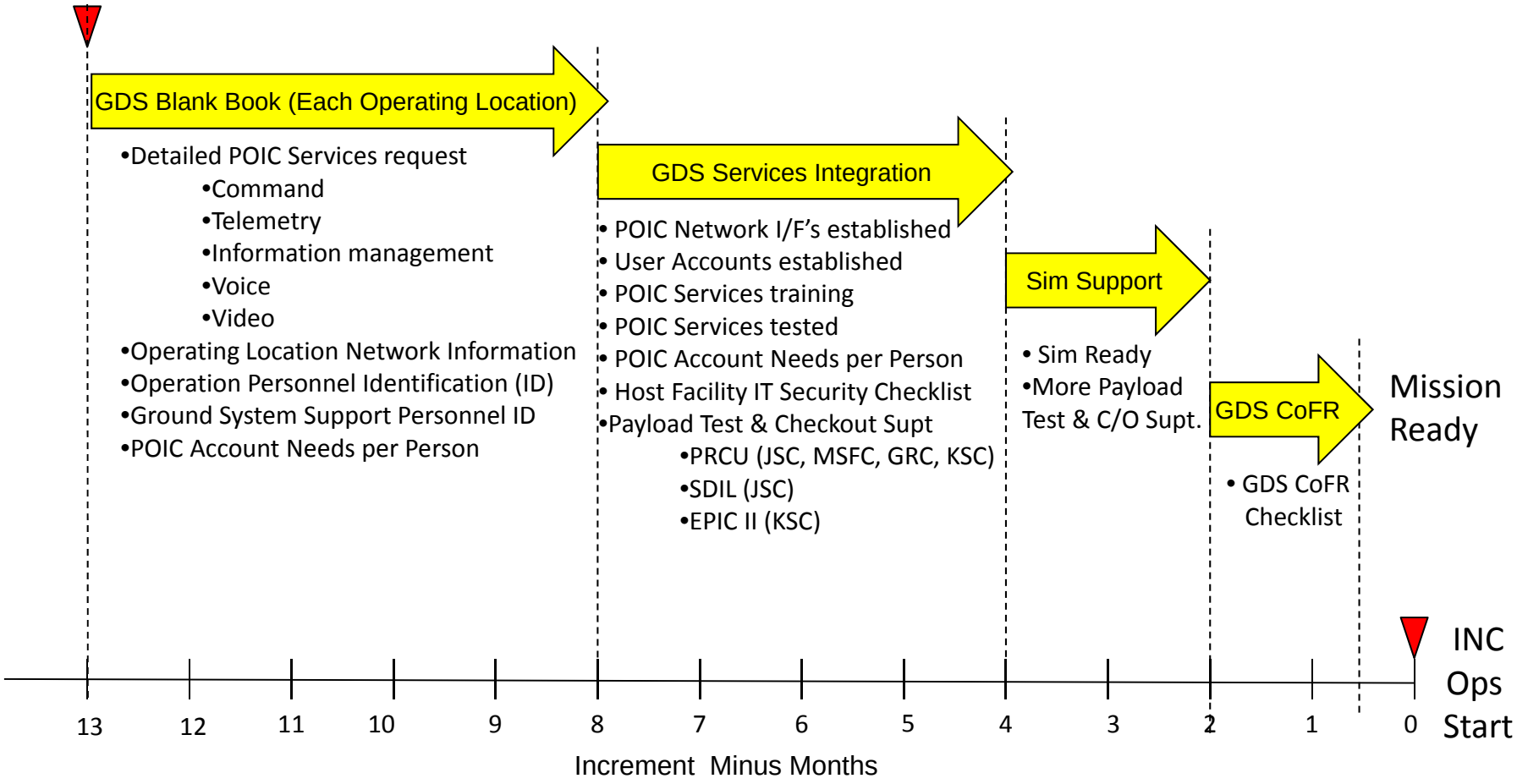
- The "IP" of the Solar System Internet is the Bundle Protocol **(BP),** which is the core of the DTN suite.
- The end-end path is rarely available due to disruptions and outages of individual links and delays are potentially very long (minutes to days) which leads to high error rates.
  - The BP routers work in a store-and-forward mode where data is held until the next hop becomes available.
  - BP often uses "Custody Transfer" to improve network efficiency – a BP router accepts custody of incoming Bundles, thus allowing the previous hop to clear its buffers.



Ground Data Service Integration Timeline

NOTE:
PIA Identified Optional Services support template varies based on complexity of need.

Signed PIA Letter
Ground Data Services



Page 15

Acronyms List

AEON Portal – Advanced Engineering Operations Network Portal
CoFR – Certification of Flight Readiness
CFDP –CCSDS File Delivery Protocol
CCSDS – Consultative Committee for Space Data Systems
DR – Data Reduction
DTN – Delay Tolerant Network
EHS – Enhanced HOSC System
EPC – EHS PC - Enhanced HOSC System Personal Computer
HOSC – Huntsville Operations Support Center
IP – Internet Protocol
IVoDS - Internet Voice Distribution System
PIMS- Payload Information Managements System
PPS – Payload Planning System
TCP – Transmission Control Protocol
TDS – Timing Distribution System
TReK – Telescience Resource Kit
TSC – Telescience Center
UDP- User Defined Protocol

Page 16